Construction Analysis for Pavement Rehabilitation Strategies

Software Integration of Design, Construction, and Traffic for Accelerated Highway Rehabilitation Projects

Increasingly, state transportation agencies are shifting focus from new construction to the rehabilitation and reconstruction of existing highways. Urban highway rehabilitation projects often create undesirable congestion, safety problems, and limited access for users who depend on the transportation facility. The question of how to economically rebuild deteriorating highways in metropolitan areas, while minimizing disruptions to the public and surrounding business is a challenging task for state transportation agencies.

One innovation in the effort to reduce highway construction time and its impact on traffic is CA4PRS (Construction Analysis for Pavement Rehabilitation Strategies), a scheduling software tool designed to help planners and designers select economical rehabilitation strategies. Developed by The Institute of Transportation Studies (ITS) at the University of California at Berkeley (UCB) with a FHWA pooled-fund grant sponsored by the State Pavement Technology Consortium (California, Minnesota, Texas, and Washington state departments of transportation), CA4PRS estimates the maximum distance and duration of highway rehabilitation or reconstruction projects under a given set of project constraints, including schedule interfaces, pavement design, construction logistics, and traffic operations.

Benefits of CA4PRS

CA4PRS is designed to identify optimal rehabilitation solutions that balance on-schedule construction production, traffic inconvenience, and agency costs. Additional benefit is realized when CA4PRS results are integrated with macroscopic and microscopic traffic simulation tools for estimating road user delay costs that arise from construction. During the design and construction phases of highway rehabilitation projects, CA4PRS helps transportation agencies, contractors, and consultants:

- develop staging construction plans,
- establish CPM schedules,
- estimate cost (A) + schedule (B) contracts, and
- calculate incentive/disincentive specifications.

Validation and Implementation

Since 1999, CA4PRS has been successfully implemented on high traffic volume urban freeway rehabilitation projects in California and other sponsoring states. The software was validated on the 2.8 lane-km I-10 Pomona project, where it was used for the estimation of slab replacement using fast-setting hydraulic cement concrete completed in one 55-hour weekend closure. The software was also used to develop a construction staging plan for the I-710 Long Beach project, where 26 lane-km of asphalt concrete was reconstructed in a series of eight 55-hour weekend closures—two weekends ahead of schedule.

More recently, the tool was used with traffic simulation models to select the most economical rehabilitation scenario for the I-15 Devore project. The 4.5-km reconstruction project, which would have taken 12 months using traditional nighttime closures, was completed over two 9-day periods using single roadbed continuous closures and around-the-clock construction. This “rapid rehab with accelerated construction” approach saved 25 percent ($6 million) in agency costs and significantly reduced road user costs.

CA4PRS was also used by Washington State DOT engineers to explore rapid rehabilitation strategies on two projects: Interstate 5

A collaboration of the following agencies:

U. S. Department of Transportation
Federal Highway Administration

Caltrans | State of Florida Department of Transportation | Minnesota Department of Transportation | Texas Department of Transportation | Washington State Department of Transportation

CA | FL | MN | TX | WA Departments of Transportation

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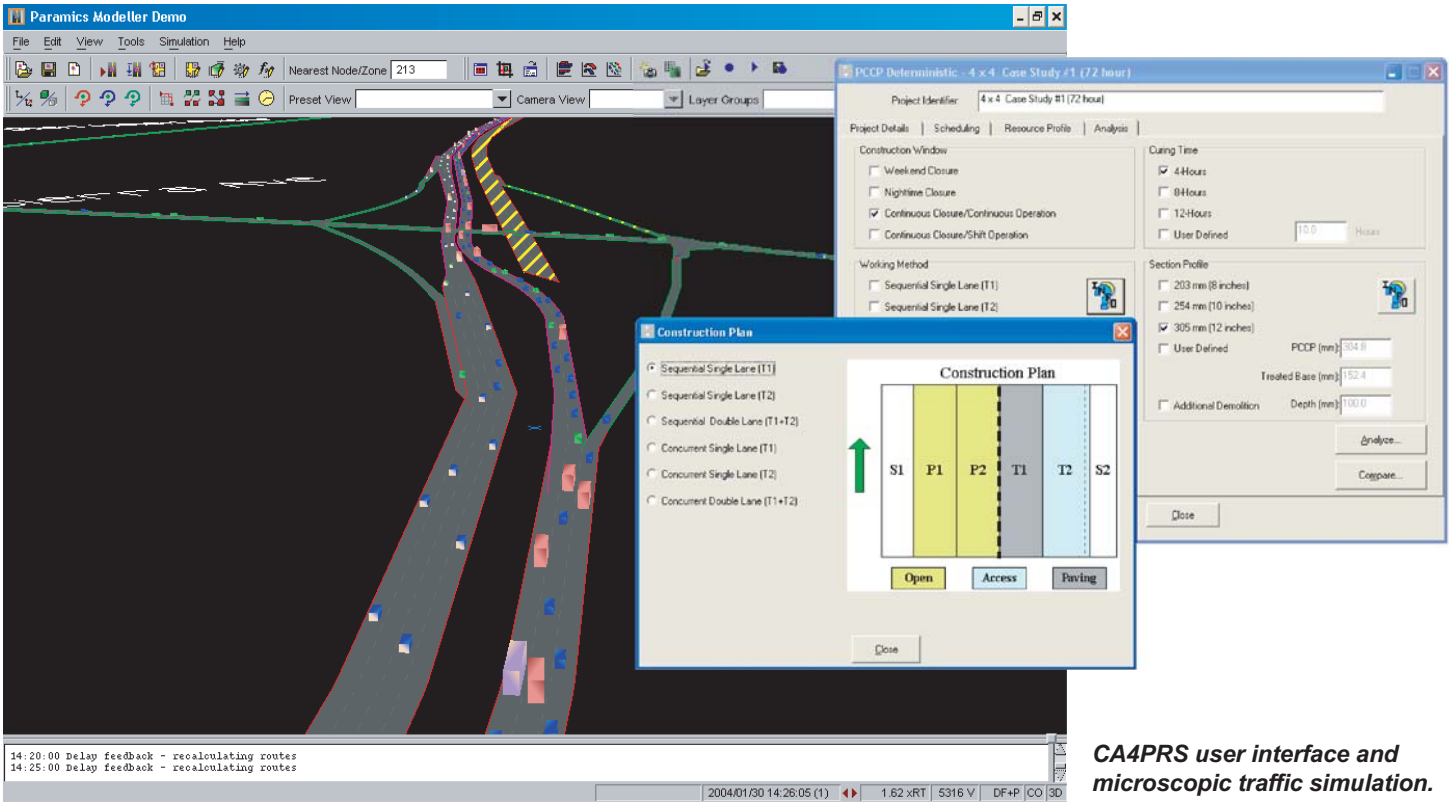

CA4PRS user interface and microscopic traffic simulation.

(I-5) in Federal Way (Seattle), where a 3-mile section will be replaced with PCC over asphalt base; and the reconstruction of a portion of southbound I-5 beneath the Convention Center in Seattle. This section is one of the highest volume locations in Washington State and is currently under construction using a scheme of four weekend closures.

In 2004, the Minnesota Department of Transportation (MNDOT) implemented CA4PRS on two resurfacing projects. Both jobs involved milling and bituminous paving: one was a nighttime operation on Interstate 494, and the other was a combination of night and complete weekend closures on Interstate 393.

Outreach

CA4PRS has been presented at national conferences and workshops hosted by the Transportation Research Board (TRB), American Association of State Highway Transportation Officials (AASHTO), and the Federal Highway Administration (FHWA), and described in transportation journal articles in TR News, and the American Concrete Paving Association (ACPA) and National Asphalt Pavement Association (NAPA) industry newsletters. Hundreds of CA4PRS posters and brochures have been distributed to potential users, and information on the software is available on the Caltrans and UC Berkeley websites.

Training workshops are being provided to pavement and traffic engineers in the contributing states. Over the last three years, about 400 transportation engineers in the sponsoring DOTs have attended 2-day intensive training seminars conducted by the primary developer of CA4PRS, Dr. E.B. Lee.

Enhancement

CA4PRS is being upgraded to improve user friendliness, add more rehabilitation strategies, and integrate with traffic simulation models. CA4PRS interim Version 1.1 will improve input interfaces, including the development of a manual to help users understand background logic, analysis processes, and the relationships of the input variables. Version 1.5 will be expanded to cover more rehabilitation features, such as the rehabilitation of continuously reinforced concrete pavement (CRCP) and dowel-bar retrofits.

In the update for the CA4PRS Version 2.0 the schedule analysis will be integrated with traffic simulation tools such as the demand-capacity model based on Highway Capacity Manual to calculate road user delay in the construction work zone, and to estimate agency construction and traffic handling costs. Eventually the concept of the total cost (as the sum of agency and road user costs) based on the scheduling, traffic, and cost analyses will be provided to select the most economical highway rehabilitation scenarios.

For More Information

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